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Vaughan

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(54) **VOIP DROP AMPLIFIER**

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(73) Assignee: **PCT International, Inc.**, Gilbert, AZ (US)

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H04J 1/02 (2006.01)

(52) **U.S. Cl.** **725/106**; 725/127; 725/126; 725/105; 370/493

(58) **Field of Classification Search** 725/106, 725/105, 126, 127; 370/493
See application file for complete search history.

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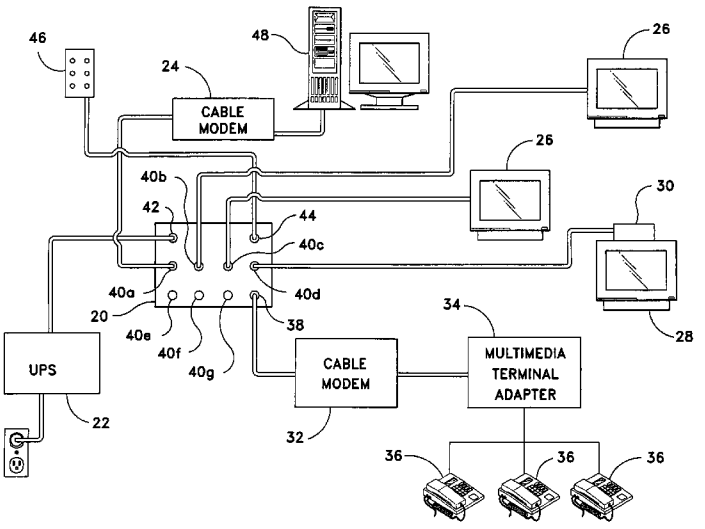
(57) **ABSTRACT**

The VOIP drop amplifier connects end user equipment to a broadband system, such as that provided by a cable provider. The amplifier includes a splitter for connecting the cable signal to multiple output connectors, and RF amplifiers compensating for losses in the splitter and other passive components in the amplifier. The drop amplifier includes an input connection for accepting a broadband cable signal from a cable system and returning broadband signals to the cable system. The drop amplifier includes an amplification path connecting the input connection to the plurality of output connections through RF amplifiers and a splitter, and a bypass path that bypass the splitter and forward and reverse amplifiers in the amplification path to connect the input connection directly to the output connection for the essential circuits. A sensing circuit monitors the amplifiers and the supply voltages, and selects the bypass path when a failure is detected.

6 Claims, 5 Drawing Sheets



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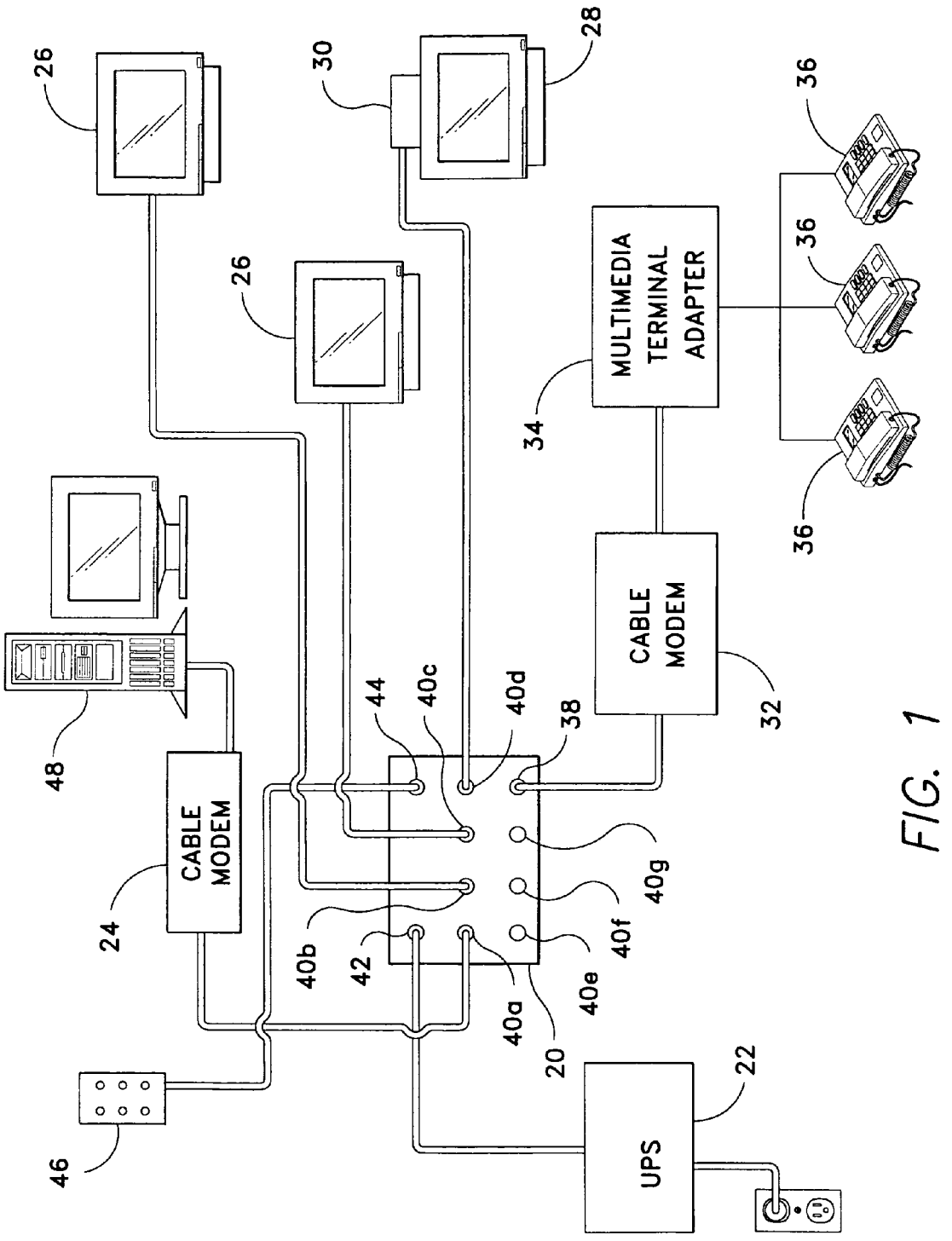

26
30
28
36
26
MULTIMEDIA TERMINAL ADAPTER
36
34
36
CABLE MODEM
32
48
44
40c
40d
38
CABLE MODEM
24
40g
40b
42
40f
40e
40a
20
22
UPS
46

FIG. 1

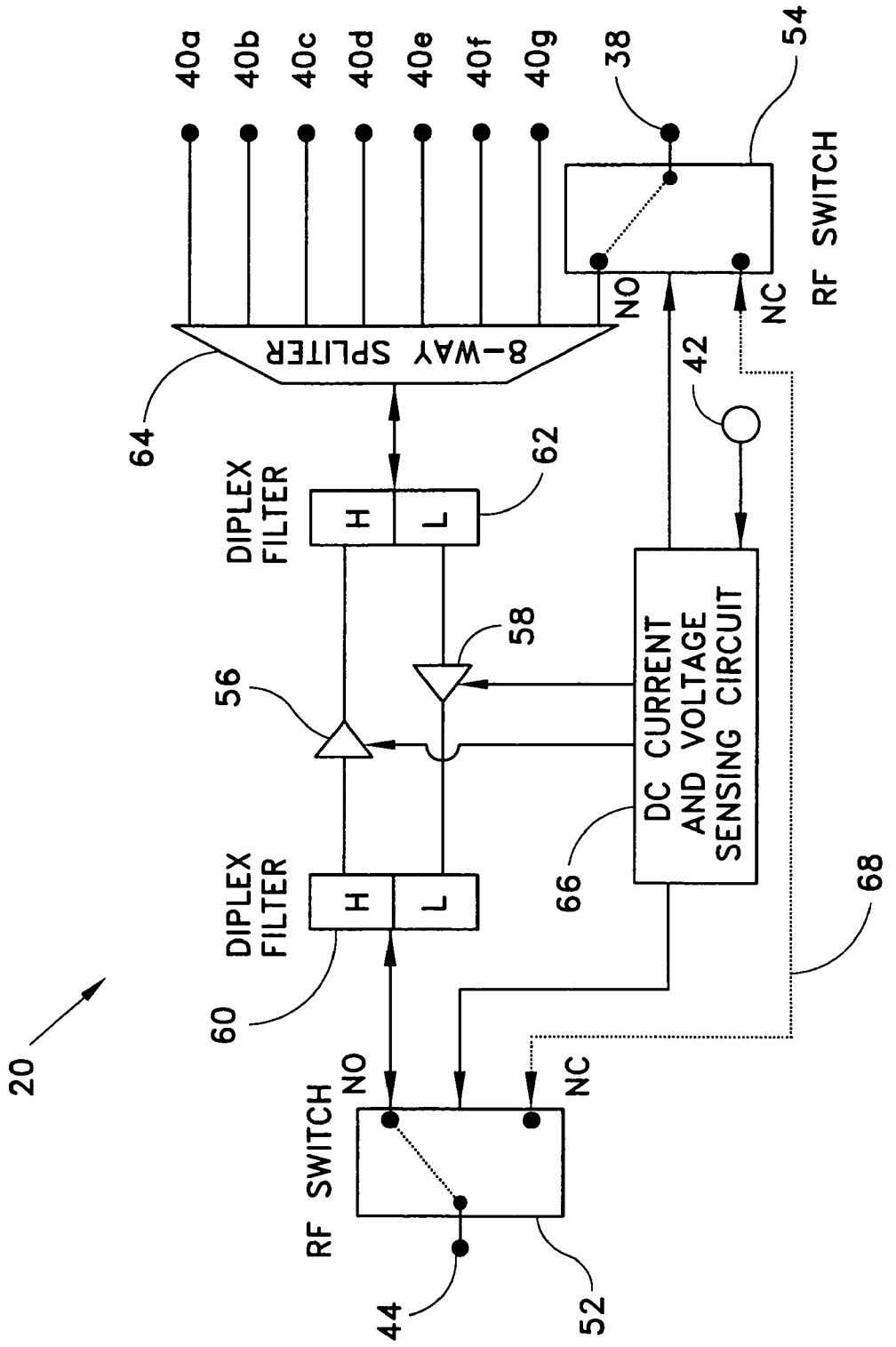
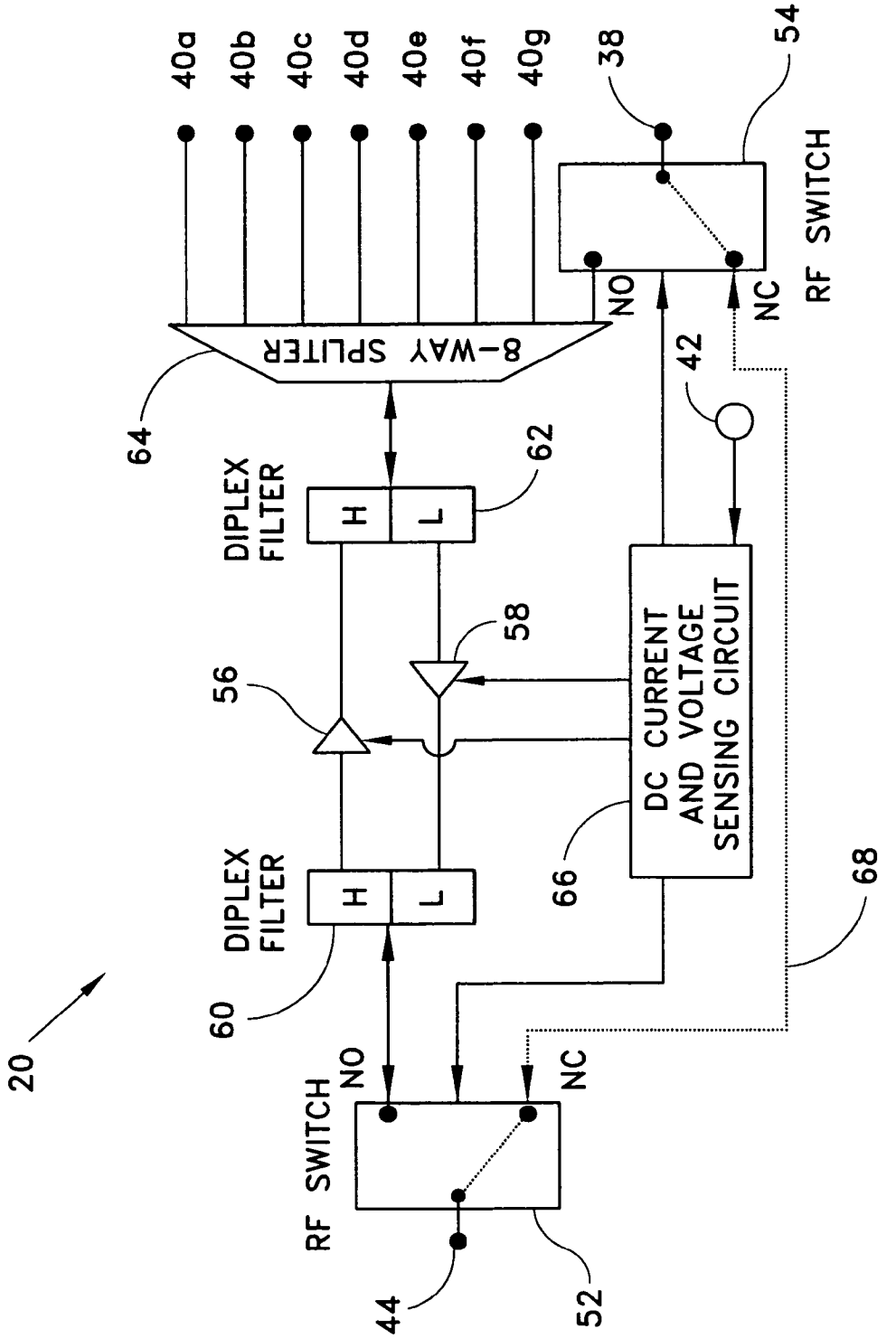

40a
40b
40c
40d
40e
40f
40g
38
54
RF SWITCH
NO
NC
8-WAY SPLITER
64
42
DIPLEX FILTER
H
L
62
58
56
DC CURRENT AND VOLTAGE SENSING CIRCUIT
66
68
DIPLEX FILTER
H
L
60
20
RF SWITCH
NO
NC
44
52

FIG. 2


20
40a
40b
40c
40d
40e
40f
40g
38
54
RF SWITCH
NO
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8-WAY SPLITTER
64
42
DIPLEX FILTER
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62
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DC CURRENT AND VOLTAGE SENSING CIRCUIT
66
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DIPLEX FILTER
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RF SWITCH
NO
NC
44
52

FIG. 3

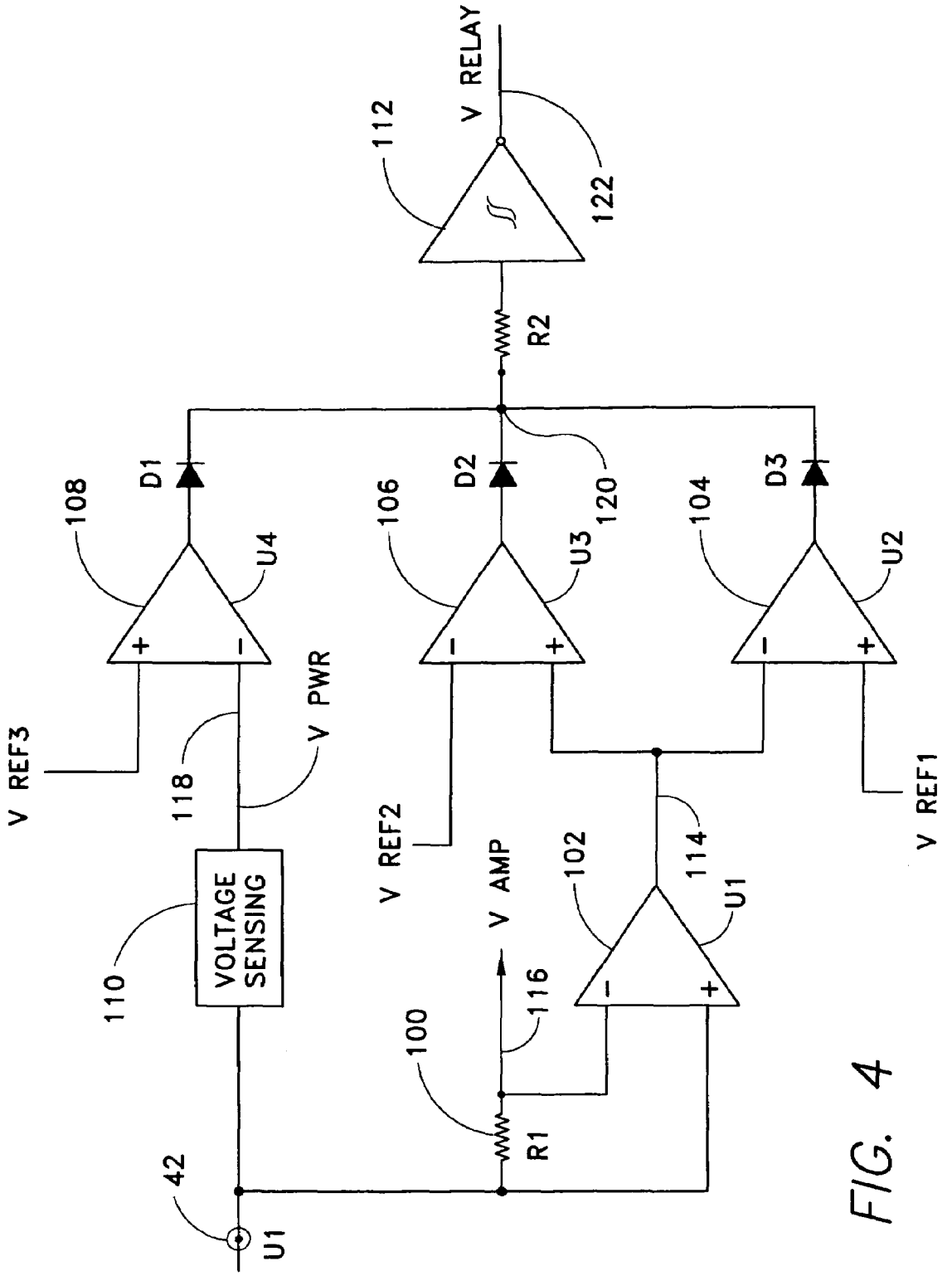
V RELAY
112
122
R2
D1
D2
D3
108
106
104
120
U4
U3
U2
V REF3
V PWR
V REF2
V REF1
118
114
102
U1
V AMP
VOLTAGE SENSING
110
116
100
R1
42
U1

FIG. 4

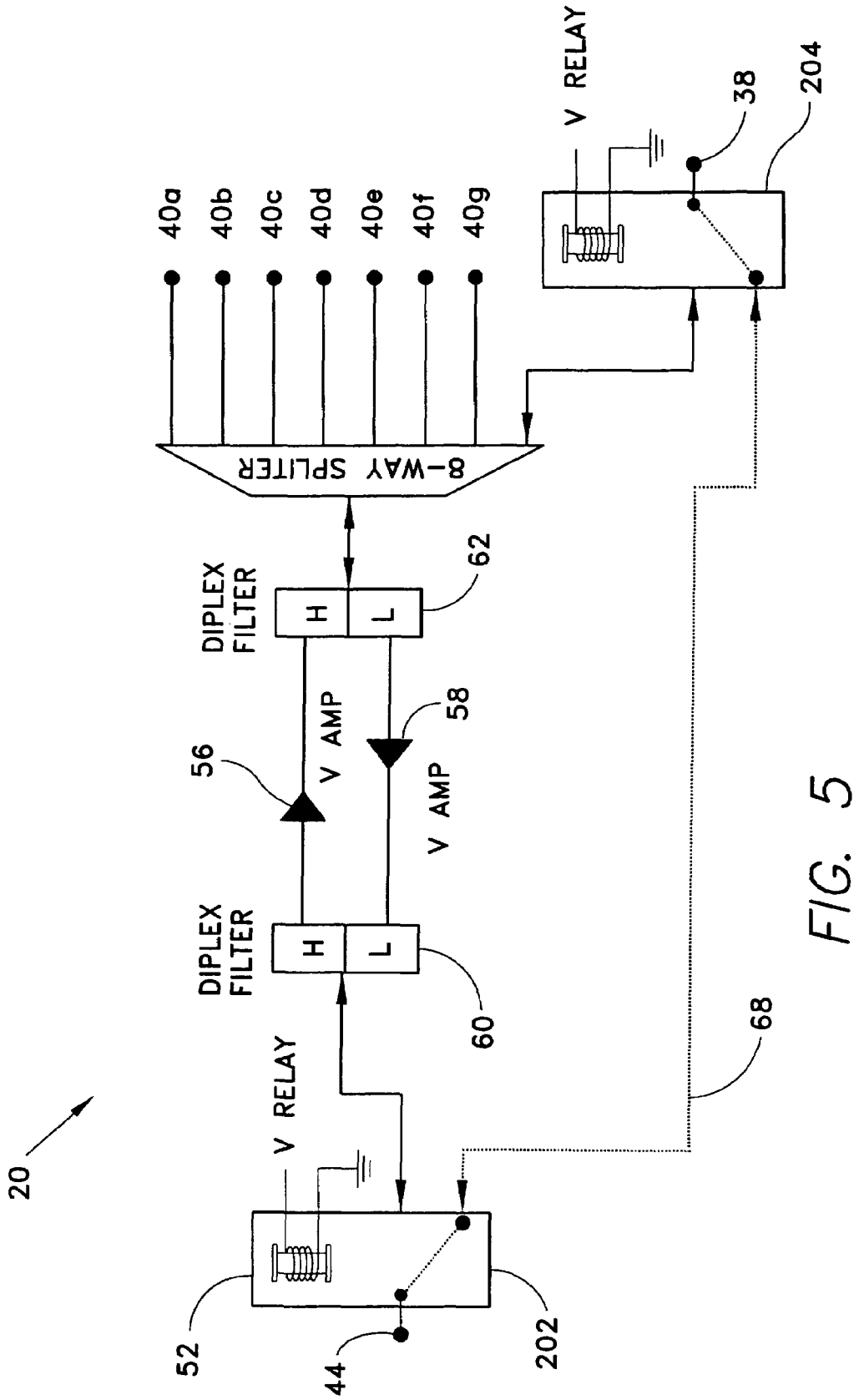
20
V RELAY
38
204
40a
40b
40c
40d
40e
40f
40g
8-WAY SPLITTER
DIPLEX FILTER
H
L
62
V AMP
58
56
V AMP
DIPLEX FILTER
H
L
60
V RELAY
68
52
44
202

FIG. 5

VOIP DROP AMPLIFIER

CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Patent Application Ser. No. 60/589,337, filed Jul. 19, 2004.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to cable television systems, and particularly to splitter/amplifier systems for delivering diverse communication services, including voice over IP (VoIP) telephone services.

2. Description of the Related Art

Cable television operators provide a variety of diverse services to consumers. These services include high speed Internet access, video on demand, pay-per-view services, and VoIP services. Cable operators provide these services multiplexed over a single cable using such techniques as frequency division multiplexing (FDM). These services are characterized by the need to provide forward and reverse communication path. The forward path is used to transmit data to the user, while the reverse path is used to return data to the cable operator. The return data might include orders for video on demand or pay-per-view content or data transmitted by the user for destinations on the Internet.

Key components of CATV systems are drop amplifiers. These amplifiers are inserted into the cable transmission path to make up for losses in the transmission system. Signals are weakened as they pass through cables and components, such as splitters. Splitters are used to separate the services provided by the cable operator for distribution to the appropriate customer equipment for receiving the service.

Typically the return signal operates at a comparatively lower frequency than the forward path. For example, in a typical system the return signal is in a bandwidth of 5 MHz to about 40 MHz, while the forward path operates at 50-1000 MHz. Diplex filters are used to separate the combined forward and return signal into separate components for amplification using separate amplifiers. In some cases the signal level in the reverse path may be sufficiently high so that no reverse path amplifier is required. For example, set top boxes and cable modems typical provide high output levels, making the reverse path amplifier unnecessary.

Among the services provided by the cable provider, it is particularly important that the voice over IP (VoIP) service be reliable. While such services as video on demand or pay-per-view are viewed as luxury or non-essential services, VoIP is used to provide telephone communications. Telephone communication are viewed as vital services, particularly during situations involving medical emergencies or natural disasters where communications may be necessary to make essential reports, such as injuries, life threatening medical conditions, or downed power lines. The VoIP circuits may be viewed as essential services because of the need to maintain the circuits in emergency situations.

Because the amplifiers used in the systems are active components employing complex circuitry and requiring electrical power to operate, the drop amplifiers are potential failure points for VoIP services. In some situations, an emergency or disaster that requires the use of the VoIP services also results in a loss of electrical power, disabling the drop amplifiers and interrupting vital VoIP communications.

Several devices have been developed for VoIP systems. A representative device is shown in Japanese Patent No. 2004-80,483, published Mar. 11, 2004, which shows in FIG. 1 a VoIP adapter for telephone communications that switches from a telephone line network, such as a packet switched telephone network, to a VoIP network to maintain communications when a failure in the telephone line network is detected. Another representative device is shown in Japanese Patent No. 2005-5,875, published Jan. 6, 2005, which also shows in FIG. 1 a device for switching from a telephone line network, such as a packet switched telephone network, to a VoIP network to maintain communications when a failure in the power supply for the telephone line network is detected.

While the above-mentioned patent references describe circuit monitoring and switching to maintain telephone communications, neither describes maintaining VoIP communications despite failure of components in an IP network providing the VoIP infrastructure.

None of the above inventions and patents, taken either singly or in combination, is seen to describe the instant invention as claimed. Thus, a VOIP drop amplifier solving the aforementioned problems is desired.

SUMMARY OF THE INVENTION

The VoIP drop amplifier connects end user equipment to a broadband system, such as that provided by a cable provider. The amplifier includes a splitter for connecting the equipment to multiple output connectors, and RF amplifiers compensating for losses in the splitter and other passive components in the drop amplifier. The drop amplifier includes an input connection for accepting a broadband cable signal from a cable system and returning broadband signals to the cable system. The drop amplifier includes an amplification path connecting the input connection to a plurality of output connections through amplifiers and a splitter, and a bypass path that bypasses the splitter and the forward and reverse amplifiers in the amplification path to connect the input connection directly to the output connection for VoIP. A sensing circuit monitors the amplifiers and the supply voltages and selects the bypass path when a failure is detected.

The amplification path includes a forward amplifier for amplifying the forward signals, which are signals originating at the cable operators system, and a reverse amplifier for amplifying the reverse signals, which are those signals originating at the end user's equipment.

The VoIP amplifier further includes a switch circuit for selecting between the amplification path and the bypass path. The switching circuit is controlled by a dc current and voltage sensing circuit.

The dc current and voltage sensing circuit monitors dc voltage supplied to the amplifier circuitry. The sensing circuitry also monitors the current supplied to the forward and reverse amplifiers, or to the forward amplifier alone when the reverse amplifier is not provided in the amplification path. The dc voltage supplied to the VoIP circuitry is compared to a reference value to determine whether the dc voltage is sufficient to operate the VoIP active components. When the dc voltage is insufficient the dc current and voltage sensing circuit operates the switching circuit to select the bypass path.

The amplifier current is compared to two reference values to determine whether the current is within a range including a lower and an upper current limit. When the amplifier current is outside this range, which corresponds to the normal range of expected amplifier currents, the dc current and voltage circuit operates the switching circuit to select the bypass path.

Under normal voltage and current conditions, the dc current and voltage sensing circuit controls the switching circuitry to select the amplification path. The bypass path sup-

plies only the VoIP output or other output connections designated as essential, while the amplification path supplies all of the output connections including the essential and non-essential connections. In a typical case, only the VoIP output is designated as essential.

The forward and reverse amplifiers may provide sufficient gain to compensate for losses in VoIP drop amplifier. Alternatively, these amplifiers may provide additional gain to compensate for losses elsewhere in the cable system, such as losses in the cable connecting the VoIP to the cable operator's system.

These and other features of the present invention will become readily apparent upon further review of the following specification and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a typical CATV system incorporating a VOIP drop amplifier according to the present invention.

FIG. **2** is a functional block diagram of the VoIP drop amplifier according to the present invention operating under normal operating conditions.

FIG. **3** is a functional block diagram of the VoIP drop amplifier according to the present invention switched to the bypass operating condition after detecting a fault in the system.

FIG. **4** is a simplified schematic diagram of an embodiment of current and voltage sensing circuitry that may be used in the VoIP drop amplifier according to the present invention.

FIG. **5** is a simplified schematic diagram of an embodiment of a VoIP drop amplifier according to the present invention using relays as the bypass switches.

Similar reference characters denote corresponding features consistently throughout the attached drawings.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is a drop amplifier designed to reliably maintain the VoIP signal path during a loss of power or a failure of active amplifying components.

FIG. **1** illustrates a system employing a VoIP drop amplifier according to the invention. The cable operator provides communication services to a multi-tap point **46**. The VoIP drop amplifier is connected to the multi-tap connection via a cable that is connected to the RF signal input connector **44**. The VoIP drop amplifier provides amplification for the forward and return signals and splits the signals, delivering them to the output connectors **38** and **40***a*-**40***g*.

Connected by cables to the output connectors are various devices for utilizing broadband cable service. Connected to output connector **40***a* is a cable modem **24** supplying an Internet connection for a personal computer **48**. Two integrated digital televisions **26** are connected to output connectors **40***b* and **40***c*. IDTV sets are television sets with the ability to interface with a broadband network to receive such services as video on demand (VOD) or electronic program guide (EPG), as well as broadcast TV. Output connector **40***d* is connected to a set top box **30**, which in turn is connected to a conventional television set **28**. Output connector **40***d* is connected to a set top box **30** that in turn is connected to a conventional (non iDTV capable) television set **28**. A set top box is common for televisions without iDTV capability. The set top box interfaces with broadband networks to deliver such services as VOD and EPG to conventional television sets.

The VoIP connector **38** is connected via a cable to a second cable modem **32**, which is connected to a multimedia terminal adapter (MTA) **34**. The MTA is connected to one or more VoIP telephones **36**. The remaining output connectors **40***e*-**40***g* are shown as unused, but may be connected to additional devices. For example, an additional cable modem and MTA may be connected to one of the unused connectors to provide additional VoIP telephone service, or a third cable modem for Internet access may be connected to one of the unused output connectors.

The VoIP drop amplifier **20** is shown powered by an uninterruptible power supply (UPS) **22**, which provides power to the VoIP drop amplifier **20** via the input connector **42**. Alternatively, power may be provided to the VoIP drop amplifier **20** from a simple wall transformer.

FIGS. **2** and **3** are block diagrams by which the basic operating principles of the VoIP drop amplifier **20** may be understood. FIG. **2** shows the amplifier in the normal condition, while FIG. **3** shows the amplifier in a bypass condition.

As shown in FIG. **2**, the RF signal to and from the cable system is routed through the input connector **44** to a first bypass switch **52**. A switch circuit comprises this first bypass switch **52**, as well as a second bypass switch **54** described below. The switch circuit is controlled by dc current and voltage sensing circuitry **66**. When the dc current and voltage sensing circuitry **66** detects that the amplifier and voltage supply is normal, the switch circuit routes the RF signal through the amplification path. To set up the amplification path, the first bypass switch **52** is set to pass the incoming signal to the first diplex filter **60**. The diplex filter separates the signal into the downstream (50-1000 MHz) signal component coming from the cable system and the upstream (5-40 MHz) signal component coming from the customer's equipment, which is directed back to the cable system. A separate upstream amplifier **56** and a downstream amplifier **58** are provided to make up for losses in passive drop amplifier components and provide unity gain. The downstream signal component originates at the cable supplier, passes through the normally open contact of the first bypass switch **52**, the first diplex filter **60**, the high frequency amplifier **56**, the second diplex filter **62**, and into the splitter **64**. After subdividing at the splitter **64**, the signal is routed to the various consumer equipment, as shown in FIG. **1**, with the exception of the VoIP telephone equipment. The path to the VoIP connector, after passing through the splitter **64**, also passes through the second bypass switch **54**. With the second bypass switch **54** in the energized condition, the downstream signal passes through the normally open contacts of the second bypass switch **54** and then to the VoIP output connector **38**.

The path for the reverse signal, originating at the consumer equipment is into the connectors **40***a*-**40***g* through the splitter **64**, into the second diplex filter **62**, through the low frequency amplifier **58**, then through the first diplex filter **60** and through the normal open contacts of the first bypass switch **52**. The VoIP reverse signal first passes though the normally open contacts of the second bypass switch **54** before entering the splitter **64**.

Preferably, the drop amplifier will provide unity gain (0 db), with losses in the passive components, such as connectors, diplex filters and splitters, being compensated for by the amplifier circuitry comprising the forward amplifier **56** and return amplifier **58**. Alternatively, additional gain may be provided by the forward and return amplifiers **56** and **58** to make up for losses external to the VoIP drop amplifier **20**.

When an abnormal condition, such as a loss of power to the VoIP drop amplifier or an abnormal operating condition of the RF amplifiers **56** and **58**, is encountered, the dc current and

voltage sensing circuit **66** switches the bypass switches **52** and **54** to the normally closed condition, as shown in FIG. **3**. In this condition, the path through the diplex filters **60** and **62**, the amplifiers **56** and **58**, and the splitter **64** is opened completely, isolating these components from the signal path. In this condition, the bypass path **68** is activated, connecting only the VoIP output connection to the cable system. If the overall gain in the normal condition was unity (0 dB), isolating the components and connecting the input connector **44** directly to the VoIP output connector **38** will restore an essentially lossless communication path through the VoIP drop amplifier **20** for the VoIP consumer telephone equipment while removing service from the other consumer equipment.

By referring to the simplified schematic diagram of FIG. **4**, the operation of dc current and voltage sensing circuitry can be understood.

The dc current and voltage sensing circuit **66** monitors the current provided to the low and high frequency amplifiers **56** and **58** (see FIGS. **2** and **3**), as well as the dc power supplied to the VoIP drop amplifier. The amplifier voltage is sampled at the VoIP power supply connector **42** via a voltage sensing circuit. The voltage sensing circuit **110** filters the dc voltage and scales the voltage using a voltage divider or other technique known in the art. The voltage at point **118** is then a scaled value representative of the voltage provided to the unit. This voltage is compared to a reference voltage V REF**3** at a first voltage comparator circuit **108**. If the scaled voltage falls below the reference voltage, indicating that the supply power is failing or has failed, the voltage comparator **108** generates a high output signal as its output.

The power supplied to the RF amplifiers (**56** and **58** in FIGS. **2** and **3**) passes through a sampling resistor R**1**, also designated **100** in FIG. **4**. The ohmic value of the sampling resistor **100** is small, so that the voltage drop across the resistor **100** does not interfere with proper operation of the RF amplifiers **56** and **58** by lowering the voltage supplied to the amplifiers at path **116**. The resistor **100** is large enough that the voltage drop across the resistor **100** is easily measurable in the current sensing circuitry. The voltage drop across the sampling resistor R**1** is amplified at an amplifying stage **102**, which generates at output **114** a voltage proportional to the combined current drawn by the RF amplifiers, and the amplifier output **114** is provided to a high current limit comparator **106** and a low current limit comparator **104**. In each circuit the RF amplifier supply current, represented by voltage output **114**, is compared to a reference value (V REF**1** or V REF**2**). If the current exceeds a high current limit value, the high limit comparator **106** generates a high voltage output value, and if the current drops below the low current limit reference value, the low limit comparator **104** generates a high voltage output signal. When the current is between the high and low levels, the high and low limit comparators generate a low voltage output. The high and low current limits are selected so that when the current draw anticipated for the RF amplifiers **56** and **58** is outside normal limits, the respective current comparator **104** or **106** generates a high output signal.

The outputs from the high limit comparator **106**, low limit comparator **104**, and the voltage comparator **108** are summed at common connection point **120**. If any of the three comparators generates a high-level voltage output, a Schmidt trigger circuit **112** trips to removes the voltage supplied at point **122**. Otherwise the Schmidt trigger circuit **112** generates a dc output signal, V RELAY, at path **122**. The voltage at path **122** is used to control the bypass switches **52** and **54** of the VoIP drop amplifier **20**. The hysteresis of the Schmidt trigger **112** results in the reset point of the Schmidt trigger **112** being appreciably lower than the trigger voltage, which prevents the bypass switches **52** and **54** from cycling between the normal and the bypass condition when the sensed voltage and current values undergo small fluctuations.

FIG. **5** is a simplified diagram showing an implementation of the bypass circuitry using relays as the bypass switch **52** and **54** components. Each relay is a single pole double throw (SPDT) type with a common pole that is connected to the normally closed contact when the relay coil is de-energized. When the relay coil is energized, the common pole is disconnected from the normally closed contact and connected to the normally opened contact. Alternatively, a single double pole double throw (DPDT) relay can provide the functionality of the pair of SPDT relays.

As shown in FIG. **5** the voltage V RELAY, which is the output of the voltage sensing circuit **66** as shown in FIG. **4**, is applied to the relay coils of two SPDT relays **202** and **204**. The common pole of the first relay **202** is connected to the cable system input connector **44** of the VoIP drop amplifier **20**. When the voltage sensing circuit **66** provides a high level output voltage for V RELAY, the relay coil of the first relay **202** is energized, connecting the input through the first diplex filter **60**, the high and low frequency amplifiers **56** and **58**, the splitter **64**, and to each of the output connectors **40***a*-**40***g*. The coil of the second relay **204** is also energized, closing its normally open contact. The second relay **204** completes the path through the splitter **64** and to the VoIP output connector **38**.

When the sensing circuit **66** detects a loss of power supply voltage or improper amplifier operation, the V RELAY voltage will be deactivated as described above, resulting in the coils of the bypass relays **202** and **204** becoming de-energized. When the relay coils are de-energized, the signal path through the amplifiers **56** and **58** and splitter **64**, or the amplification path, is isolated by opening of the normally open relay contacts. The normally closed contacts of the bypass relays **202** and **204** are then closed to complete a bypass path **68**, connecting the cable system to the VoIP output **38**. Because the splitter **64** is bypassed in this condition, the bypass path **68** is nearly lossless. If the VoIP drop amplifier **20** is designed for unity gain, the VoIP output connector **38** will be supplied with essentially the same signal level in the bypass condition as in the normal condition. Non-essential consumer equipment, such as the PC Internet connection, will be disconnected from the cable signal when the VoIP drop amplifier **20** is in the bypass condition.

A complete loss of all power supplied to the VoIP drop amplifier **20** will result in disabling the voltage and current sense circuitry **66**. Because the bypass path through the amplifier **20** is selected using the normally closed contacts of the bypass switches **52** and **54**, the loss of power to the VoIP drop amplifier **20** will result in bypassing the de-energized active circuitry and the splitter **64** of the drop amplifier **20**, thus maintaining a loss-free connection to the consumer's VoIP telephone equipment.

In an example implementation, the reverse amplifier **58** comprises an RF Micro Devices RF2317 integrated circuit based RF amplifier, while the forward amplifier **56** comprises an ANADigics Inc. ADA10000 integrated circuit based broadband RF amplifier. The comparator circuits **104**, **106**, and **108** are implemented using conventional operational amplifier circuits, such as the LM2900. The current supplied to the two RF amplifier circuits passes through a 1-ohm resistor **100**, developing a voltage across the resistor **100** proportional to total amplifier current. This voltage is compared to reference voltage supplied to the current comparators **104** and **106** to implement the high and low current limits

described above. The low current limit is approximately 180 milliamps (mA), while the high current limit is at approximately 300 mA. The nominal expected current draw for the amplifier circuitry is 250 mA. The current limit values are chosen to be consistent with the range of expected currents for the particular amplifier circuits used in the VoIP drop amplifier **20**. When amplifier current is outside of the expected range of values, the dc current and voltage sensing circuit **66** removes the voltage to the coils of the bypass relays **52** and **54**, switching the circuit into the bypass condition described above. After a trip due to an out-of-range current, the VoIP resets when the current increases to 200 mA or decreases below 280 mA due to the hysteresis of the Schmidt trigger **112** circuitry. The voltage sensing circuitry conditions the incoming voltage using filters and surge suppressors, and then employs a voltage divider network to provide a voltage proportional to the supply voltage. This voltage is compared to a reference voltage developed from an integrated circuit voltage regulator to establish the low voltage trip point. The low voltage limit is approximately 13 volts, with the normal supply voltage for the VoIP being 15-volts dc. When the supply voltage drops below the low voltage limit, the voltage and current sensing circuit **66** removes the voltage to the coils of the bypass relays **52** and **54**, switching the circuit into the bypass condition described above. After a trip due to a low supply voltage, the VoIP resets to use the amplification path when the voltage increases to at least 14 volts due to the hysteresis of the Schmidt trigger **112** circuitry. The circuit components, voltages and currents described above are by way of example and do not limit the invention to the particular components and circuit values detailed.

The dc current and voltage sensing circuit may use other means of detecting faults in the drop amplifier circuitry. For example, the integrated circuit amplifiers used to implement the forward and reverse amplifiers may include an output signal indicating normal operation of the amplifier. The dc current and voltage sensing circuitry could detect the loss of the normal operation signal and trigger the selection of the bypass path. In addition to sensing the dc voltage supplied to the unit, the dc voltage and sensing circuit may sample an ac supply voltage by rectifying and filtering the ac voltage to obtain a dc voltage representative of the ac supply voltage. The representative dc voltage may be compared to a reference and the results of the comparison may be used to control the bypass circuit.

Separate sensing resistors may be provided in the respective current paths supplying the forward and reverse amplifiers. By providing separate sensing resistors, and separate pairs of low and high current comparator circuits, the currents provided to the forward and reverse amplifiers can be monitored separately rather than as a combined value. The current set points of set of low and high current comparators are chosen based on the expected operating currents for the respective amplifier.

In another variation of the VoIP drop amplifier, the amplifier circuitry may include a forward amplifier but no reverse amplifier. This configuration is useful when user components such as a set top box or a cable modem generate reverse signals at sufficiently high levels so that amplification of the return signal from these user components.

It is to be understood that the present invention is not limited to the embodiments described above, but encompasses any and all embodiments within the scope of the following claims.

I claim:

1. A VoIP drop amplifier for connecting equipment to a broadband signal, the VoIP drop amplifier comprising:

an input connector for accepting a broadband cable signal from a cable system and returning broadband signals to the cable system;

a plurality of output connectors including at least one non-essential output connector and at least one essential input connectors, the at least one essential output connector including an output adapted for connection to VoIP telecommunication equipment;

an amplification path connecting the input connector to the plurality of output connectors, the amplification path having:

a diplex filter for separating the broadband signal into return and forward signals;

amplifier circuitry comprising a forward amplifier for amplifying the forward signals;

a return path for the return signals; and

a splitter for connecting signals traveling on the amplification path to each of the plurality of output connectors;

a bypass path connecting the input connector to the at least one essential output connector;

a switching circuit for switching between the amplification path and the bypass path; and

a dc current and voltage sensing circuit connected to the switching circuit for to selecting the bypass path upon dc current and voltage sensing circuit detecting an abnormal condition and for selecting the amplification path when the dc current and voltage sensing circuit does not detect an abnormal condition, the dc current and voltage sensing circuit comprising:

a circuit for detecting total dc current powering the amplifier circuitry;

a first comparator circuit for comparing the total dc current powering the amplifier circuitry to a high current limit and generating a first output based on the comparison;

a second comparator circuit for comparing the total dc current powering the amplifier to a low current limit and generating a second output based on the comparison, the low current limit being lower than the high current limit;

a circuit for monitoring dc voltage supplied to the reverse amplifier and the forward amplifier, and

a voltage comparator circuit for comparing dc voltage supplied to the amplifier circuitry to a low voltage limit and for generating an output based on the voltage comparison, the abnormal condition being detected when the first output exceeds the high current limit, the second output is less than the low current limit, or the output based on the voltage comparison detects dc voltage supplied to the amplifier circuitry less than the low voltage limit.

2. The VoIP drop amplifier according to claim **1**, wherein said amplification path further comprises a reverse amplifier in the path for the return signals for amplifying the reverse signals.

3. The VoIP drop amplifier according to claim **1**, wherein the switching circuit comprises an input RF switch having:

a first normally open contact connected to the amplification path;

a first normally closed contact connected to the bypass path; and

a first common contact connected to the input connection, the input RF switch being operable to switch between connecting the first normally open contact to the first common contact, and connecting the first normally closed contact to the first common contact.

4. The VoIP drop amplifier according to claim 3, wherein the switching circuit comprises an output RF switch having:

a second normally open contact connected to the amplification path;

a second normally closed contact connected to the bypass path; and

a second common contact connected to the at least one essential output connector, the output RF switch being operable to switch between connecting the second normally open contact to the second common contact, and connecting the second normally closed contact to the second common contact.

5. A VoIP drop amplifier for connecting equipment to a broadband signal, the VoIP drop amplifier comprising:

an input connector adapted for accepting a broadband cable signal from a cable system and returning broadband signals to the cable system;

a plurality of output connectors, the output connectors having at least one non-essential output connector and at least one essential output connector, the at least one essential output connector including an output adapted for connection to VoIP telecommunication equipment;

an amplification path connecting the input connector to the plurality of output connectors, the amplification path having:

a diplex filter for separating the broadband signal into return and forward signals;

a forward amplifier for amplifying the forward signals;

a reverse amplifier for amplifying the return signals; and

a splitter for connecting signals traveling on the amplification path to each of the plurality of output connectors;

a bypass path connecting the input connector to the at least one essential output connector;

a switching circuit for switching between the amplification path and the bypass path; and

a dc current and voltage sensing circuit connected to the switching circuit for selecting the bypass path upon the dc current and voltage sensing circuit detecting an abnormal condition, and for selecting the amplification path when the dc current and voltage sensing circuit detects the absence of an abnormal condition.

6. The VoIP drop amplifier according to claim 5, wherein said dc current and voltage sensing circuit further comprises

a first circuit for sensing a first dc current powering the forward amplifier;

a second circuit for sensing a second dc current powering the reverse amplifier;

a first comparator circuit for comparing the first dc current powering the forward amplifier to a first high current limit and generating a first output based on the comparison;

a second comparator circuit for comparing the first dc current powering the forward amplifier to a first low current limit and generating a second output based on the comparison, the first low current limit being lower than the second current high current limit;

a third comparator circuit for comparing the second dc current powering the reverse amplifier to a second high current limit and generating a third output based on the comparison;

a fourth comparator circuit for comparing the second dc current powering the reverse amplifier to a second low current limit and generating a fourth output based on the comparison, the second low current limit being lower than the second current high current limit;

output generating circuitry for generating an abnormal condition detection output for detecting an abnormal condition, the abnormal condition detection output depending on the first output, the second output, the third output, and the fourth output.

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